ISS Electrospray Production of Photovoltaics, Phase I

Completed Technology Project (2018 - 2019)

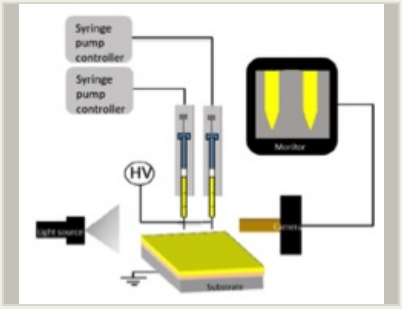
Project Introduction

Manufacturing in space has been a long-term goal for the International Space Station (ISS). It is important both as a way to potentially produce high value materials such as some drugs that can be created more efficiently in the microgravity environment as well as a way to demonstrate that Lunar and Martian outposts can manufacture some of their own needed supplies on-site. Multiple prior experiments have been developed to demonstrate the manufacturing of specialized materials onboard ISS, including infrared ZBLAN optical fiber that avoids internal crystallization effects in microgravity, and parts produced through 3D printing. The objective of this program is to develop an ISS experimental package to demonstrate the onboard production of photovoltaic cells and arrays. NanoSonic would develop electrospray techniques compatible with the microgravity environment for the direct and complete printing of large-scale perovskite solar cells (PSCs) and arrays. Unlike ink jet printing that sprays liquid drops of ink that would spatially wander in microgravity, electrospray methods use high voltage to rapidly accelerate materials onto charged substrates so no release of liquids occurs. PSCs have been developed rapidly during the past five years to currently exhibit power conversion efficiencies (PCEs) greater than 20%. Electrospray printing of PSCs would allow the rapid, low cost manufacturing of large area and mechanically flexible and stowable solar array fabrics, and their fabrication onboard ISS would demonstrate the production of materials that are needed in space. Through the Phase I SBIR program, NanoSonic would work through a subcontract with Professor Shashank Priya, a leader in the development of perovskite solar cell technology at Penn State University, and informally with aerospace engineers at a major U.S. aerospace company to consider onboard ISS experimental system requirements.

Anticipated Benefits

NASA would use the developed automated module onboard ISS to demonstrate the manufacturing of electronics in space. This would support the development of commercial manufacturing in space and demonstrate the production of electronics away from earth. NASA could use high efficiency solar cells produced onboard ISS in future missions that require increased electrical power, including fixed space platforms such as the Deep Space Gateway or outposts on the surfaces of the moon or Mars.

Flexible, low cost, highly efficient PSCs would have application in PV fabric-based tents, backpacks and vehicles, as an alternative power source in remote locations along rural highways or recreation areas off the grid, and as a replacement for rigid rooftop and backyard PV structures that provide lower PCEs. Low-cost electrospray additive manufacturing units could be used by industry, researchers and individuals to make their own photovoltaic fabrics and arrays and other electronic devices.



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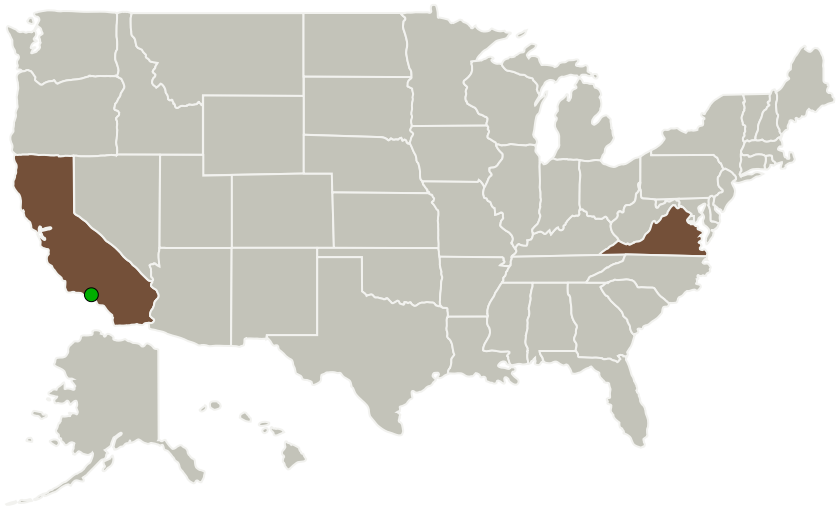
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nanosonic, Inc.	Lead Organization	Industry	Pembroke, Virginia
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Virginia

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137848)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nanosonic, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

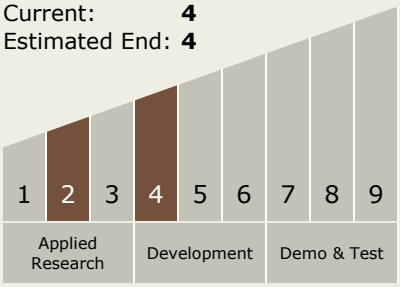
Carlos Torrez

Principal Investigator:

Richard O Claus

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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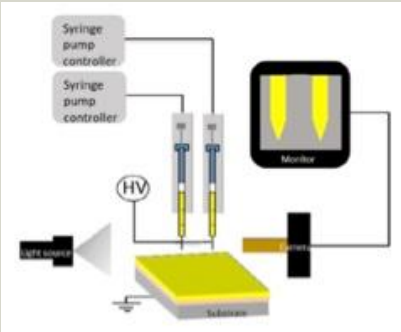
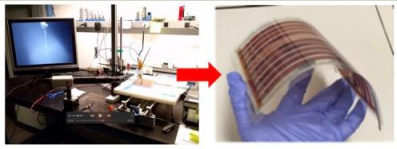
Images



Briefing Chart Image
ISS Electrospray Production of Photovoltaics, Phase I
(https://techport.nasa.gov/image/126347)



Final Summary Chart Image
ISS Electrospray Production of Photovoltaics, Phase I
(https://techport.nasa.gov/image/129031)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

Earth, The Moon, Mars